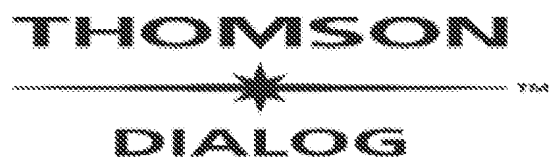


Report Information  
from Dialog DataStar



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## A flexible multimodal object tracking system.

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### Author(s)

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### Abstract

In this paper we present a flexible multimodal **object tracking** system. It is based on a particle filter, which combines the outputs of different measurement methods (also called modes or cues) in a flexible manner. The modes for locating the desired **object** can be selected depending on the specific **object**, which is to be **tracked**, and the environment of the **object**. By combining multiple modes we aim to add the strengths while at the same time to overcome the specific disadvantages of the different modes. Thus the robustness of the **tracking** system will be increased and a successful **tracking** will be possible in critical situations where a system using only a single mode would fail. We have used this approach for **tracking** persons in different environments. The measurement modes, which we have implemented for this purpose, are a pseudo 2–dimensional **hidden Markov** model (P2DHMM), a color based skin finder, and a motion detector. We describe the theory and the architecture of this **tracking** system and finally depict some exemplary results.

### Descriptors

**HIDDEN–MARKOV–MODELS; KALMAN–FILTERS; OBJECT–DETECTION; TRACKING.**

### Classification codes

B6135 Optical–image–and–video–signal–processing\*;  
B6140B Filtering–methods–in–signal–processing;  
B0240J **Markov**–processes;  
C5260B Computer–vision–and–image–processing–techniques\*;  
C1140J **Markov**–processes.

### Keywords

**multimodal**–object–tracking; particle–filters; pseudo–2–dimensional–  
**hidden**–Markov–model; color–based–skin–finder; motion–detector;  
multiple–modes.

### Treatment codes

P Practical;  
T Theoretical–or–mathematical.

### Language

English.

### Publication type

Conference–paper.

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**Improved person tracking using a combined pseudo-2D-HMM and Kalman filter approach with automatic background state adaptation.**

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**Source**

Proceedings 2001 International Conference on Image Processing (Cat. No.01CH37205), 2001, vol.2, p. 53–6 vol.2, 6 refs, pp. 3 vol.(lxx +1133+1108+1110), ISBN: 0–7803–6725–1. Publisher: IEEE, Piscataway, NJ, USA.

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**Abstract**

This paper presents the continuation of our work on **object tracking** in presence of non-stationary background using a combination of a pseudo-2D **hidden Markov** model (P2DHMM) and a **Kalman** filter. It presents a major improvement by introducing a novel method that allows an automatic adaptation of our system to the changing background. Other improvements of the system's **tracking** capabilities are achieved by refined person models and normalization procedures. One of the major goals of our approach to **tracking** is to achieve high quality **tracking** results despite non-stationary background that can be caused e.g. by moving objects in the background or by camera operations such as panning or zooming. In previous publications we demonstrated that our combined **P2DHMM**/Kalman filter approach is an interesting solution to this problem, because it enables us to perform person **tracking** without the use of motion information. In this paper, we show that this approach can be further improved by adapting the system to the constantly changing background. We further demonstrate that such a background adaptation is very difficult to achieve in standard **tracking** approaches but can be effectively realized in our combined **P2DHMM**/Kalman filter approach. The effectiveness of this new procedure is demonstrated in experiments, where the **tracking** results and the quality of the person segmentation of our original system is compared to the results obtained with the improved approach.

**Descriptors**

FILTERING–THEORY; **HIDDEN**–MARKOV–MODELS; IMAGE–MOTION–ANALYSIS; IMAGE–SEGMENTATION; IMAGE–SEQUENCES; **KALMAN**–FILTERS; **TRACKING**; VIDEO–SIGNAL–PROCESSING.

**Classification codes**

B6135 Optical–image–and–video–signal–processing\*;  
B6140B Filtering–methods–in–signal–processing;  
B0240J **Markov**–processes;  
C5260D Video–signal–processing\*;  
C1140J **Markov**–processes.

**Keywords**

**person**–tracking; pseudo-2D-HMM; **Kalman**–filter; automatic–background–state–adaptation; **object**–tracking; nonstationary–background;  
**pseudo**–2D–hidden–Markov–model; refined–person–models; normalization–procedures; moving–objects; camera–operations; panning; zooming;  
background–adaptation; **tracking**–results; person–segmentation–quality;

video-sequences.

**Treatment codes**

T Theoretical-or-mathematical;

X Experimental.

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**Publication type**

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## Search Strategy

No.	Database	Search term	Info added since	Results
1	INZZ	object ADJ track\$3	unrestricted	3066
2	INZZ	markov	unrestricted	50937
3	INZZ	hidden ADJ markov	unrestricted	9984
4	INZZ	kalman	unrestricted	21621
5	INZZ	1 AND 3 AND 4	unrestricted	3

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